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SOME MICROPLANKTON FROM THE PALEOCENE RIVERNOOK BED, VICTORIA

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Abstract

Four new species of microplankton are described and twelve previously described species are recorded from a sample taken from the base of the Rivernook Bed of the Dilwyn Clay, Victoria. Brief mention is made of a few of the pollen and spore types present.

Introduction

By D. J. TAYLOR

In this paper, Dr Isabel Cookson and Professor A. Eisenack are describing the microplankton content of a sample from the base of the Rivernook Bed of the Dilwyn Clay from the Pebble Point to Princetown Coastal section of Baker (1953). The sample was collected from 20 ft below the Upper Paleocene 'Rivernook foraminiferal fauna' of McGowran (1965). The base of the Rivernook Bed is mainly dark grey carbonaceous pyritic siltstone with some lenses of light green (grey on dehydration) micaceous, glauconitic clay. This green clay contained 75 per cent planktonics in a total count of 500 foraminiferal specimens per 100 gms. As this is the highest planktonic foraminiferal percentage in the Victorian Paleocene, I submitted this sample for microplankton examination.

McGowran (l.c.) considered his 'Rivernook foraminiferal fauna' to be correlative with the *Globorotalia pseudomenardii* subzone of the Tethyan belt and thus of Upper Paleocene age. McGowran's fauna contained *Globorotalia aequa* Cushman & Renz, without the older related species *G. angulata* (White) and *G. apanthesma* Loeblich & Tappan. The basal Rivernook 'green clay' contains a planktonic fauna which includes the three species *G. aequa, G. angulata* and *G. apanthesma*, implying that the fauna is distinct and older than McGowran's sample. I have described this 'green clay' fauna in manuscript and consider it to be near the top of the *Globorotalia pusilla pusilla-G. angulata* Zone of the Tethyan belt; thus on the Middle/Upper Paleocene boundary.

Harris (1965) has described and discussed the microfloral content of the Rivernook Bed, but his sample (S212) was from the same position as McGowran's (1965) foraminiferal sample. Harris placed his Rivernook sample within his *Triorites edwardsii-Duplopollis orthoteichus* Concurrent Range Zone: an overlapping biostratigraphic interval between the *T. edwardsii* Zone of the underlying Middle Paleocene Pebble Point Formation and the overlying Upper Paleocene *D. orthoteichus* Zone of the main part of the Dilwyn Clay.

Cookson (1965b) and Cookson & Eisenack (1965c) have described microplankton from the underlying Pebble Point Formation. Deflandre & Cookson (1955) have described microplankton from the overlying Princetown Member of the Dilwyn Clay (then considered Lower Eocene—now Upper Paleocene).

Systematic Descriptions*

Class Dinophyceae

Family Deflandreaceae Eisenack

Genus **Deflandrea** Eisenack 1938

Deflandrea obliquipes Deflandre & Cookson

(Pl. 39, fig. 9-10, P25949)

Deflandrea dartmooria Cookson & Eisenack 1965b, p. 133, Pl. 16, fig. 2.

Comment: Specimens referable to *D. obliquipes*, previously recorded from two Victorian Paleocene deposits, namely the Pebble Point Formation and the Upper portion of the Dilwyn Clay, occur sparingly in the Rivernook sample. They approximate closely in shape, size-range, the inconspicuousness of the girdle, shape of archeopyle and the faintly granular ornamentation of both shell and capsule to the examples on which the species was based.

Dimensions: Overall length 109-130 μ, breadth 62-74 μ.

Deflandrea dartmooria Cookson & Eisenack

(Pl. 39, fig. 7, 8, P25948)

Deflandrea dartmooria Cookson & Eisenack 1965b, p. 133, Pl. 16, fig. 2.

Comment: A single specimen which is clearly referable to *D. dartmooria* from the Paleocene Dartmoor Formation, Victoria, has been recovered from the Rivernook sample. It approximates closely to the Dartmoor specimens in size, shape, the well-developed girdle, the hexagonal outline of the archeopyle, the presence, shape and position of the flagellum-pore and the surface ornamentation. Owing to the rather crushed condition of the specimen, the tabulation, though evident, is rather obscured.

Dimensions: Overall length 130 μ, width 80 μ.

Deflandrea sp.

(Pl. 39, fig. 6, P25947)

Age and Occurrence: Paleocene. Rivernook Member of Dilwyn Clay, Victoria.

Description: Shell small, thin-walled, untabulated, with convex sides, a rather large straight-sided triangular to nearly cylindrical blunt apical horn and two rather short, widely-spaced divergent triangular antapical horns. Girdle relatively broad, shallow, approximately equatorial, longitudinal furrow relatively broad and shallow. Capsule large, filling the shell laterally. Surface of shell coarsely and closely granular, especially along the rims of the girdle.

Dimensions: Figured specimen 90 × 62 μ.

Comment: Only a few examples have been seen and all have been rather crushed.

Genus **Wetzeliella** Eisenack 1938

Wetzeliella hyperacantha Cookson & Eisenack

(Pl. 40, fig. 11, P25955)

Wetzeliella hyperacantha Cookson & Eisenack 1965b, p. 134, Pl. 16, fig. 3-6.

* The figured specimens are in the palaeontological collection of the National Museum of Victoria. Numbers prefaced by the letter P are registered numbers in that collection.

COMMENT: *W. hyperacantha* appears to be of rare occurrence in the Rivernook sample. The example figured herein comes within the range allowed for *W. hyperacantha* from the type locality, the Dartmoor Formation, Victoria.

Family HYSTRICHOSPHAERACEAE Evitt

Genus **Achomosphaera** Evitt 1963

Achomosphaera ramulifera (Deflandre)

(Pl. 41, fig. 2, P24771)

Hystrichosphaeridium ramuliferum Deflandre, 1937, p. 74-75, Pl. 15, fig. 5-6; Pl. 17, fig. 10.
Hystrichosphaeridium ramuliferum Deflandre; W. Wetzel 1952, p. 398, Pl. A, fig. 9.
Hystrichosphaeridium ramuliferum Deflandre; Gocht 1959, p. 71, Fig. 9.
Hystrichosphaeridium ramuliferum Deflandre; Gerlach 1961, p. 185, Pl. 2, fig. 3.
Achomosphaera ramulifera (Deflandre) Evitt 1963, p. 163, Fig. 4.
Achomosphaera ramulifera (Deflandre) Cookson & Hughes 1964, p. 45, Pl. 9, fig. 10.

COMMENT: Two specimens which appear to come within the range of *A. ramulifera* have been recovered from the Rivernook sample. On one side of the figured specimen, in the region of the girdle, a 'double' process somewhat similar to, but less pronounced than those of the type specimen, is present. Evitt (1963) has stated that 'undescribed species of the genus have been observed in strata ranging from Albian to Lower Tertiary in age'. On this account, therefore, in spite of some differences, the Victorian examples are being associated with the type species.

DIMENSIONS: Figured specimen—overall 130 × 120 μ, shell 76-68 μ.

Family HYSTRICHOSPHAERIDIACEAE Evitt

Genus **Cordosphaeridium** Eisenack 1963

Cordosphaeridium inodes (Klumpp)

(Pl. 41, fig. 1, P25982)

Hystrichosphaeridium inodes Klumpp 1953, p. 311, Pl. 18, fig. 1-2.
Hystrichosphaeridium inodes Klumpp; Deflandre & Cookson 1955, p. 277, Pl. 8, fig. 7.
Hystrichosphaeridium inodes Klumpp; Gerlach 1961, p. 186, Pl. 28, fig. 4-5.
Cordosphaeridium inodes (Klumpp) Eisenack 1963, p. 118, Fig. 3.
Cordosphaeridium inodes (Klumpp) Cookson & Eisenack 1967, Pl. 3, fig. 12.

COMMENT: Several specimens referable to *C. inodes* have been recovered from the Rivernook sample. *C. inodes,* originally described and subsequently recorded from several European Lower Tertiary localities, has already been reported from three Australian deposits; the Princetown Member of the Dilwyn Clay and the Birregurra Bore between 760-761 ft and 959-960 ft in Victoria (Deflandre & Cookson 1955) both of Paleocene age (Harris 1965, p. 78) and a Lower Tertiary (probably Upper Paleocene) deposit near Strahan, Tasmania (Cookson & Eisenack 1967).

Cordosphaeridium bipolare Cookson & Eisenack

(Pl. 39, fig. 1-5, P24764-24768)

Cordosphaeridium bipolare Cookson & Eisenack 1965b, p. 135, Pl. 16, fig. 7-8.

COMMENT: The specimens from the Rivernook Formation herein associated with *C. bipolare*, whilst varying to a certain degree from those of the type locality, the Dartmoor Formation, Victoria, have been found to vary equally amongst themselves. However, the differences between the representatives of the two localities do not appear, on present knowledge, to be sufficient to justify specific separation.

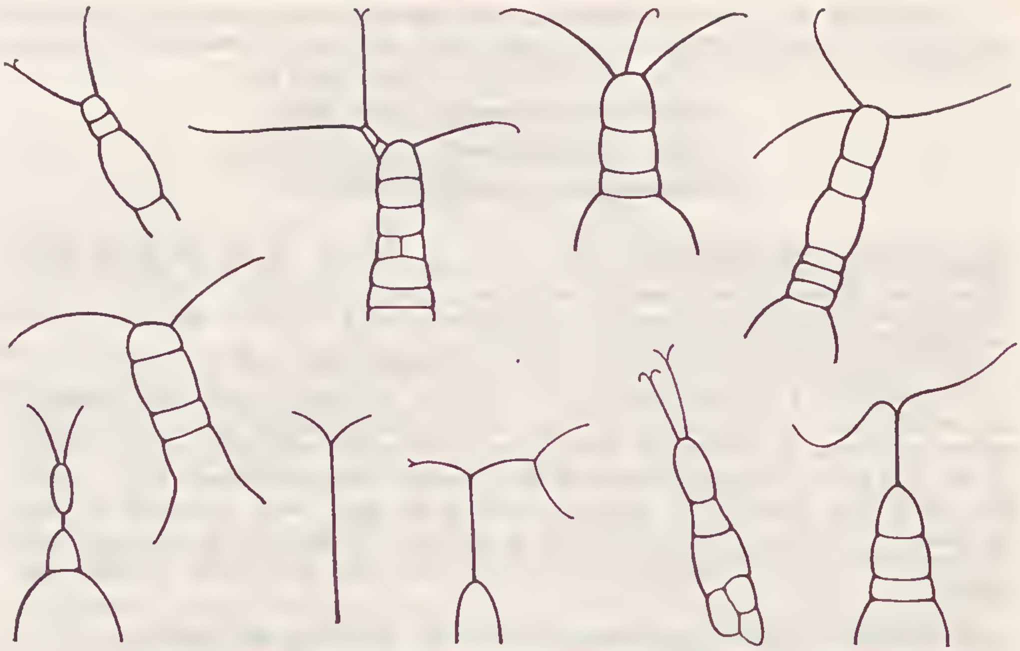

FIG. 1—*Baltisphaeridium* septatum. Sketches of appendages. × *c.* 4000.

Such differences are: (1) In some of the Rivernook examples (Pl. 39, fig. 1-3) the small solid apical horn developed from the outer thin granular layer of the shell-wall is borne on a more or less prominent median apical projection of the smooth inner layer of the shell-wall—a feature not seen in any of the Dartmoor examples. (2) The number and width of the appendages in individual examples and in one and the same example from the Rivernook sample vary considerably. The appendages of the examples shown in fig. 1, 2 approach most closely in size and form those of the holotype and paratype from the Dartmoor Formation—those shown in fig. 4, 5, on the contrary, are much narrower, some almost thread-like, *c.* 1 μ wide, and more sparsely developed. In the latter examples, both horns resemble those of the type.

The justification for placing the Rivernook specimens in *Cordosphaeridium* is the general flattening of the apices of the appendages and the presence in a few of the wider ones of fine longitudinal striations. Very occasionally as in *P. inodes* sub. sp. *gracilis* (Eisenack 1954) a bifurcation is observable (Pl. 39, fig. 3).

Genus **Hystrichokolpoma** Klumpp

Hystrichokolpoma rigaudae Deflandre & Cookson

(Pl. 40, fig. 10, P25977)

Hystrichokolpoma rigaudae Deflandre & Cookson 1955, p. 279, Pl. 6, fig. 6, 10. 42.
Hystrichokolpoma rigaudae Deflandre & Cookson; Maier 1959, p. 311, Pl. 31, fig. 2.
Hytrichokolpoma rigaudae Deflandre & Cookson; Gerlach 1961, p. 183, Pl. 27, fig. 8, 9.
Hystrichokolpoma rigaudae Deflandre & Cookson; Rossignol 1964, p. 89, Pl. 2, fig. 5, Pl. 3, fig. 8.
Hystrichokolpoma rigaudae Deflandre & Cookson; Cookson & Eisenack 1965a, p. 129, Pl. 13, fig. 13, 14.

COMMENT: One well preserved, although incomplete specimen has been recovered from the Rivernook sample. The recorded time-range of this species in Victoria is from Upper Paleocene (Princetown Member of the Dilwyn Clay) to Upper Eocene (Browns Creek Clay). In Europe its recorded range is from Eocene (Maier 1959) to Pleistocene (Rossignol 1964).

Genus **Diphyes** Cookson

Diphyes colligerum (Deflandre & Cookson)

(Pl. 41, fig. 3, P25983)

non *Hystrichosphaeridium* sp. *c*. Cookson 1953, Pl. 2, fig. 29-30.
Hystrichosphaeridium colligerum Deflandre & Cookson 1955, p. 278, Pl. 7, fig. 3.
Hystrichosphaeridium colligerum Deflandre & Cookson; Cookson & Eisenack 1961, p. 44, Pl. 2, fig. 9.
Baltisphaeridium colligerum (Deflandre & Cookson) Downie & Sargeant 1963, p. 91.
Diphyes colligerum (Deflandre & Cookson) Cookson 1965a, p. 86, Pl. 9, fig. 1-12.
Diphyes colligerum (Deflandre & Cookson) Cookson & Eisenack 1967, p. 134, Pl. 17, fig. 7.

COMMENT: *D. colligerum* has been of regular occurrence in residues of the Rivernook sample. One feature of some of the examples, not previously observed, is the occurrence of a small median antapical projection of the wall of the shell (Pl. 41, fig. 3).

The known time-range of *D. colligerum* in Victoria is fairly long, from Upper Cretaceous (probably Senonian) to the Upper Eocene Browns Creek Greensand (Cookson 1965a). *D. colligerum* has also been recorded from a Paleocene deposit (Harris 1965, p. 100) in Western Australia (Cookson & Eisenack 1961) and recently from one near Strahan, Tasmania (Cookson & Eisenack 1967, p. 134).

Family AREOLIGERACEAE Evitt

Genus **Cyclonephelium** Deflandre & Cookson

emend Cookson & Eisenack 1962

Cyclonephelium reticulosum Gerlach

(Pl. 41, fig. 5-6, P25985-6)

Cyclonephelium reticulosum Gerlach 1961, p. 204, Pl. 29, fig. 2.

COMMENT: A number of specimens which appear referable to *Cyclonephelium reticulosum* Gerlach from German Oligocene deposits have been recovered from the Rivernook sample. They are also closely similar to the well-preserved specimen from the Paleocene Pebble Point Formation, earlier questionably compared with *C. reticulosum* (Cookson 1965b, Pl. 24, fig. 10). It now seems reasonably certain that this example and the ones from the Rivernook sample are specifically related and referable to the European species.

Cyclonephelium retiintextum Cookson 1965

(Pl. 41, fig. 4, P25984)

Cyclonephelium retiintextum Cookson 1965a, p. 88, Pl. 24, 16, fig. 8, 8a-9.
Cyclonephelium retiintextum Cookson 1965b, p. 137, Pl. 24, fig. 8-11.

COMMENT: Specimens referable to *C. retiintextum* have been fairly frequent in residues obtained from the Rivernook sample. They are distinguishable from those of *C. reticulosum* by the simple, looped and wide-meshed character of the network which is situated within the margin of the body. *C. retiintextum* originally based on two specimens obtained from Upper Cretaceous cuttings from a bore in south-western Victoria, was subsequently found in abundance in samples taken near the base of the Paleocene Pebble Point Formation in SW. Victoria (Cookson 1965b).

Family Uncertain

Genus **Kenleyia** Cookson & Eisenack 1965

Kenleyia fimbriata n. sp.

(Pl. 40, fig. 1-7; holotype, fig. 3, P24769)

AGE AND OCCURRENCE: Upper Paleocene. Rivernook Member of Dilwyn Clay, Victoria.

DESCRIPTION: Shell broadly oval, somewhat flattened, typically with a relatively short, solid, blunt or sharply-pointed apical and antapical horn and usually an indistinctly delimited girdle (Pl. 40, fig. 6). The surface is more or less clearly marked out into a few large, approximately circular areas by vertical lace-like fringes of varying widths. Usually these areas, which frequently are most clearly outlined on the dorsal surface to the right and left of the mid-line, pass over the lateral margins to the ventral surface. The archeopyle is rather large, precingular and hoof-shaped. The surface of the shell is finely and closely granular.

DIMENSIONS: Holotype—overall length *c.* 118 μ, overall breadth *c.* 104 μ; shell *c.* 88 $\times$ 80 μ. Range—overall length *c.* 100-120 μ, overall breadth *c.* 84-112 μ.

COMMENT: The association of the above-described type with the genus *Kenleyia* is based on a similarity as regards shape, the development of both apical and antapical horns, a large precingular archeopyle and to a lesser degree, the type of ornament.

In the latter respect *K. fimbriata* approaches most closely to *K. lophophora* Cookson & Eisenack (1965, 1967) from two Paleocene deposits, namely the Dartmoor Formation, Victoria and the one near Strahan, Tasmania. It differs from the great majority of specimens of *K. lophophora* in the fact that (1) the fibrils composing the external ornament are fused distally with the formation of lace-like membranes of varying widths and (2) that these expansions do not cover the whole shell, but merely delimit the large roughly circular areas into which the surface of the shell is more or less clearly divided.

As regards the type of ornament, it now seems that one of the figured specimens from the Dartmoor Formation ascribed to *K. lophophora* (Cookson & Eisenack 1965, Pl. 17, fig. 10) may be closer to, if not identical with *K. fimbriata*. However, in it the subdivision of the surface is not evident.

Kenleyia pachycerata Cookson & Eisenack

(Pl. 40, fig. 8, P25975)

Kenleyia pachycerata Cookson & Eisenack 1965, p. 136, Pl. 17, fig. 1-3.

COMMENT: A few specimens referable to *K. pachycerata* from the Paleocene Dartmoor Formation have been recovered from the Rivernook sample.

Genus **Thalassiphora** Eisenack & Gocht 1960

Thalassiphora flammea n. sp.

(Pl. 42, fig. 1-5; holotype, fig. 1, P24760)

AGE AND OCCURRENCE: Upper Paleocene. Rivernook Member of the Dilwyn Clay, Victoria.

DESCRIPTION: Shell approximately oval, rather thick-walled with a sub-apical archeopyle and a finely reticulate to more or less open lace-like wing.

DIMENSIONS: Holotype—shell *c.* 82 μ long, *c.* 72 μ broad, archeopyle *c.* 30 $\times$ 24 μ; wing *c.* 50 μ wide.

COMMENT: *T. flammea* agrees in general features with *T. velata* (Deflandre & Cookson 1955) from two Western Australian Lower Tertiary deposits (Cookson & Eisenack 1962). However, in *T. velata* the wing-like expansions are so faintly patterned as to give a general impression of smoothness and entirety, in contrast to the more coarsely dotted to finely open lacey appearance characteristic of *T. flammea.*

T. flammea differs from the type species *T. pelagica* (Eisenack 1954) from European Eocene deposits, in the absence of an antapical projection and type of wing structure. In the Victorian specimen shown in Pl. 42, fig. 4, at present associated with *T. flammea*, the wing, which is complete, is narrower (5-24 μ wide) and thicker and denser than those of the type and other examples from the Rivernook sample. An example, apparently closely related to *D. flammea* though with a still more open wing structure, is present in a preparation of a deposit in the Nelson Bore, SW. Victoria at 730 ft (P25978).

Group ACRITARCHA

Subgroup ACANTHOMORPHITAE

Genus **Baltisphaeridium**

Baltisphaeridium liniferum n. sp.

(Pl. 40, fig. 9, paratype, P25976; Pl. 41, fig. 7, 8; fig. 7, P25987; fig. 8, holotype, P25990)

AGE AND OCCURRENCE: Upper Paleocene. Rivernook Member of the Dilwyn Clay, Victoria.

DESCRIPTION: Shell slightly oval with a moderately thick, faintly granular to smooth wall, an apical archeopyle and a variable number of solid appendages of variable size and shape.

The appendages, which are generally solid throughout their length, bi- or trifurcate distally into short or longish thread-like branches, with pointed or bifurcate tips. The bases of the appendages, which occasionally may be hollow, are frequently broadened and root-like and characteristically connected with those of neighbouring appendages, by narrow straight or curved strands which, in some deeply stained examples, appear as lightish lines on the coloured surface (Pl. 40, fig. 9).

DIMENSIONS: Holotype—overall width *c.* 108 μ; shell *c.* 67 μ long, *c.* 75 μ broad; appendages *c.* 16-30 μ long. Range—shell *c.* 65-75 μ broad, appendages *c.* 12-27 μ long, *c.* 1-3 μ wide.

Baltisphaeridium septatum n. sp.

(Pl. 42, fig. 6-10; holotype, fig. 6, P25979; paratype, fig. 8, P25980); Fig. 1)

Hystrichosphaera crassipellis Deflandre & Cookson; Gerlach 1961, p. 177, Pl. 27, fig. 5; Fig. 16, 17, 23.

AGE AND OCCURRENCE: Upper Paleocene. Rivernook Member of Dilwyn Clay, Victoria.

DESCRIPTION: Shell spherical, thin-walled with a closely and rather coarsely, apparently granular surface and a variable number of radially arranged appendages which approximate in length to the radius of the shell. A 'marginal zone' often present, giving the impression that the shell is thick-walled, is, in fact, due to compression.

The appendages vary in size, shape and structure. The majority narrow somewhat from a broadened base and divide distally into two or three straight or curved tapering branches with closed, pointed or minutely bifurcate tips. The larger appendages are typically hollow and septate throughout (Pl. 42, fig. 9, 10; Fig. 1); in the finer to thread-like ones, on the contrary (Pl. 42, fig. 8) the degree of septation is often difficult to determine and their distal portions, at least, appear to be solid. A few of the appendages are unbranched. A pylome has been seen in a few specimens (Pl. 42, fig. 7).

Dimensions: Holotype—overall diameter *c.* 80 μ; diameter of shell *c.* 57 μ, appendages *c.* 10-18 μ long. Range—shell diameter *c.* 42-58 μ.

Comment: At first sight the shape and wall structure of the shell of *Baltisphaeridium septatum* suggested a possible affinity with *Hystrichosphaera crassipellis* (Deflandre & Cookson 1955). However a re-examination of the holotype of *H. crassipellis* has shown that, although in it no trace of the tabulation characteristic of the genus *Hystrichosphaera* exists, the two largest and best preserved of the appendages are open distally, non-septate, and have a granular surface (Pl. 42, fig. 11, 12), all characters which clearly separate it from *Baltisphaeridium septatum*.

One of us (A.E.) has had the opportunity of re-examining in the light of the present investigation, the specimens from the Oligocene and Miocene deposits of West Germany upon which Gerlach (1961) based her record of the species *Hystrichosphaera crassipellis* mentioned above. This reinvestigation has shown that the shells of the German specimens are completely untabulated, that the appendages are closed distally and that some, at least, are hollow and septate, not perforated as Gerlach states, all characters suggestive of a close relationship with *B. septatum* rather than with *H. crassipellis* as established by Deflandre & Cookson. The actual wall structure of *B. septatum* is very difficult to determine and it seems quite likely that, were sections to be obtained, the surface pattern would prove to be reticulate rather than granular as suggested above.

Subgroup Sphaeromorphitae

Genus **Leiosphaeridia** Eisenack 1958

Leiosphaeridia trematophora Cookson & Eisenack

(Pl. 40, fig. 12, P25956)

Leiosphaeridia trematophora Cookson & Eisenack 1967, p. 136, Pl. 19, fig. 13.

Comment: The single specimen recovered from the Rivernook sample is comparable with those from a Paleocene deposit, near Strahan, Tasmania (Cookson & Eisenack 1967) and an Upper Eocene deposit at Browns Creek, Victoria (Cookson & Eisenack 1965).

Pollen and Spores (I.C.C.)

Although no attempt is being made to give a detailed record of the pollen and spore content of the Rivernook sample under consideration, mention of the occurrence of two readily recognizable types of some stratigraphical interest seems desirable. These are the pollen types *Proteacidites pachypolus* Cookson & Pike 1954 and *Monosulcites prominatus* McIntyre 1965. The occurrence of four remanié forms will be noted.

Proteacidites pachypolus (Pl. 41, fig. 9) whilst not abundant, has been regularly present in preparations of the Rivernook sample. This well-characterized type has been recorded by Cookson & Pike (1954) from several Australian Lower Tertiary deposits and by Harris (1965) from the Upper Paleocene Princetown Member of the Dilwyn Clay which directly overlies the Rivernook Member from which the sample studied was taken.

Monosulcites prominatus (Pl. 4, fig. 10), a fossil pollen type structurally similar to pollen of the Palm, *Lepidocaryum gracile* (cf. Erdtman 1952, p. 305, Fig. 177B), was originally described and recorded by McIntyre (1965) from Paleocene to Middle Eocene deposits in New Zealand. Specimens closely similar to *M. prominatus* are now known from three Australian Paleocene deposits, namely the Dartmoor Formation (recorded from thence under the name *Baltisphaeridium taylori* by Cookson & Eisenack 1965b), the Rivernook sample under consideration (Pl. 41, fig. 10) and a deposit of probable Upper Paleocene age near Strahan, Tasmania (Cookson & Eisenack 1967, Pl. 18, fig. 8-12).

Of the remaining spore types observed in residues of the Rivernook sample, a species of the Permian genus *Nuskoisporites* Potonie & Klaus is the most conspicuous. This form has been previously recorded from Cretaceous and several Lower Tertiary deposits in south-eastern Australia (Cookson 1955) and from the Princetown Member of the Dilwyn Clay (Harris 1965).

One specimen which agrees with *Potoniesporites* sp. remanić in the Princetown Member of the Dilwyn Clay (Harris 1965, Pl. 2, fig. 1) has been recovered from the Rivernook sample.

Two readily recognizable Cretaceous sporotypes which may possibly be derived forms, namely *Pilosisporites notensis* Cookson & Dettmann and *Rousisporites reticulatus* Pocock (cf. Dettmann 1963) have been present in residues of the Rivernook sample.

Conclusion

It is noted in the introduction that the basal Rivernook sample examined is probably within Harris's (1965) *Triorites edwardsii-Duplopollis orthoteichus* Concurrent Range Zone. However, although neither of the sporomorphs *Triorites edwardsi* and *Duplopollis orthoteichus* was observed, the presence of *Proteacidites pachypolus* suggests Harris's *D. orthoteichus* Zone which is high in the sequence and equivalent to Microflora C of Cookson (1954).

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Explanation of Plates

Plate 39

Fig. 1-5—*Cordosphaeridium bipolare* Cookson & Eisenack. 1, 2, 5 × *c.* 450, 3, 4 × *c.* 600. Hypotypes (P24764-24768).

Fig. 6—*Deflandrea* sp. × *c.* 600 (P25947).

Fig. 7, 8—*Deflandrea dartmooria* Cookson & Eisenack. Ventral and dorsal surfaces of the same specimen × *c.* 450 (P25948).

Fig. 9, 10—*Deflandrea obliquipes* Deflandre & Cookson. 9 × *c.* 450, 10 × *c.* 400. (P25949.)

PLATE 40

Fig. 1-7—*Kenleyia fimbriata* n. sp. 1-6 × *c.* 450; 3 holotype (P24769); paratypes, 1 (P25970), 2 (P25971), 4 (P24770), 5 (P25972), 6 (P25973), 7 × *c.* 430 (P25974).
Fig. 8—*Kenleyia pachycerata* Cookson & Eisenack × *c.* 450 (P25975).
Fig. 9—*Baltisphaeridium liniferum* n. sp.; paratype × *c.* 450 (P25976).
Fig. 10—*Hystrichokolpoma rigaudae* Deflandre & Cookson × *c.* 450 (P25977).
Fig. 11—*Wetzeliella hyperacantha* Cookson & Eisenack × *c.* 550 (P25955).
Fig. 12—*Leiosphaeridia trematophora* Cookson & Eisenack × *c.* 400 (P25956).

PLATE 41

Fig. 1—*Cordosphaeridium inodes* Eisenack & Gocht × *c.* 430 (P25982).
Fig. 2—*Achomosphaera ramulifera* (Deflandre) × *c.* 430 (P24771).
Fig. 3—*Diphyes colligerum* (Deflandre & Cookson) × *c.* 650 (P25983).
Fig. 4—*Cyclonephelium retiintextum* Cookson × *c.* 450 (P25984).
Fig. 5, 6—*Cyclonephelium reticulosum* Gerlach × *c.* 450 (P25985-6).
Fig. 7, 8—*Baltisphaeridium liniferum* n. sp., 7 (P25987) × *c.* 450, 8 holotype × *c.* 500 (P25990).
Fig. 9—*Proteacidites pachypolus* Cookson & Pike × *c.* 450.
Fig. 10—*Monosulcites prominatus* McIntyre × *c.* 450.
Fig. 11—*Nuskoisporites* sp. × *c.* 330.

PLATE 42

Fig. 1-5—*Thalassiphora flammea* n. sp. 1, holotype (P24760) × *c.* 450; 2-5 × *c.* 450. Fig. 5 paratype (P24761).
Fig. 6-10—*Baltisphaeridium septatum* n. sp. 6, holotype (P25979) × *c.* 600, 7, showing archeopyle × *c.* 600; 8, paratype (P25980) × *c.* 1000; 9, 10, appendages × *c.* 1200 (P25981).
Fig. 11-12—*Hystrichosphaera crassipellis* Deflandre & Cookson, two appendages of holotype × *c.* 1200.